Core Skill Lab

Chemical Bonds

Chemical compounds are combinations of atoms held together by chemical bonds. These chemical bonds are of two basic types—ionic and covalent. Ionic bonds result when one or more electrons from one atom or group of atoms is transferred to another atom. Positive and negative ions are created through the transfer. In covalent compounds no electrons are transferred; instead electrons are shared by the bonded atoms.

The physical properties of a substance, such as melting point, solubility, and conductivity, can be used to predict the type of bond that binds the atoms of the compound. In this experiment, you will test six compounds to determine these properties. Your compiled data will enable you to classify the substances as either ionic or covalent compounds.

OBJECTIVES

Compare the melting points of six solids.

Determine the solubilities of the solids in water and in ethanol.

Determine the conductivity of water solutions of the soluble solids.

Classify the compounds into groups of ionic and covalent compounds.

Summarize the properties of each group.

MATERIALS

- 24-well reaction plate
- citric acid
- calcium chloride
- phenyl salicylate
- potassium iodide
- sodium chloride
- sucrose
- aluminum foil
- ethanol
- thin-stemmed pipettes (2)
- conductivity tester
- Bunsen burner
- ring stand & iron ring
- lab apron
- safety goggles

 **Always wear safety goggles and a lab apron to protect your eyes and clothing.** If you get a chemical in your eyes, immediately flush the chemical out at the eyewash station while calling to your teacher. Know the location of the emergency lab shower and eyewash station and the procedures for using them.

 **Do not touch any chemicals.** If you get a chemical on your skin or clothing, wash the chemical off at the sink while calling to your teacher. Make sure you carefully read the labels and follow the precautions on all containers of chemicals that you use. If there are no precautions stated on the label, ask your teacher what precautions to follow. Do not taste any chemicals or items used in the laboratory. Never return leftovers to their original container; take only small amounts to avoid wasting supplies.

 **Do not heat glassware that is broken, chipped, or cracked.** Use tongs or a hot mitt to handle heated glassware and other equipment because hot glassware does not always look hot.

When using a Bunsen burner, confine long hair and loose clothing. If your clothing catches on fire, WALK to the emergency lab shower and use it to put out the fire.

Procedure

1. Put on safety goggles and a lab apron.
2. Before you begin, write a brief description of each of the six substances in **Table 1.**
3. Fold a sheet of aluminum foil three or fold times to make a rectangle. Fold the edges of the rectangle up about half a centimeter on all the sides to make a small lip on all the edges. This will keep any of the chemicals from spilling off of the foil.
4. Place your new aluminum foil tray on an iron ring attached to a ring stand. Position the ring so that it is about three or four centimeters above the tip of a low/yellow Bunsen burner flame. Instead of the candle as shown in **Figure 1** below, you will use a low/yellow flame on a Bunsen burner. Light the Bunsen burner for a moment to check that you have the correct height.
5. Use a pencil (not a pen) to label the aluminum foil tray with the each of the chemicals. Assign each of the chemicals a number and write that number write directly on the aluminum foil with the pencil. Space the numbers out as far apart as possible on the aluminum foil tray.
6. Place a few crystals of sucrose, sodium chloride, phenyl salicylate, calcium chloride, citric acid, and potassium iodide in separate locations on the lid, as shown in **Figure 2.** Place the same amount of each crystal on the tray. Do not allow the samples of crystals to touch. Draw and label a diagram that shows the position of each compound.

NOTE: Modify diagrams below to show aluminum foil tray instead of tin can lid.

Figure 1

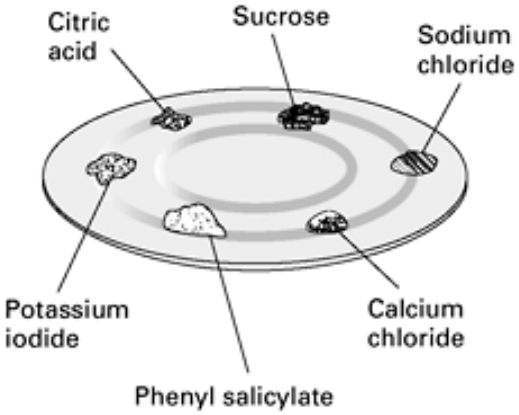

Figure 2

5. For this experiment, it is not necessary to have exact values for the melting point. The aluminum foil tray will continue to get hotter as it is heated, so the order of melting will give relative melting points. Light the Bunsen burner, pick it up by the base and move the flame slowly and uniformly back and forth underneath the aluminum foil tray. Observe. Note the substance that melts first by writing a **1** in **Table 1.** Record the order of melting for the other substances with consecutive numbers.

   CAUTION: If any of the crystals melt and spill into each other, the mixture may ignite. If it does so, DON'T PANIC, just let it burn out and continue with the experiment.

6. After 2 min, record an ***n*** in **Table 1** for each substance that did not melt. Extinguish the burner flame. Allow the can lid to cool while you complete the remainder of the experiment.

7. Put a *few* crystals of each of the white solids in the top row of your reaction plate. IMPORTANT: Be sure and use just a *few* crystals and the *same amount* of crystals for each chemical. Repeat with the second row using the *same amount* of crystals as in the first row.

8. Add 10 drops of water to each well in the top row. Do not stir. Record the solubility of each substance in **Table 1.** If you added too much of each crystal and none of them has dissolved, you may need to add more water. Use the code **S** for soluble, **P** for partially soluble, and **N** for not soluble.

9. Add 10 drops of ethanol to each well in the second row of the reaction plate. Do not stir. Record the solubility of each substance in **Table 1.** Use the code **S** for soluble, **P** for partially soluble, and **N** for not soluble.

10. Go back and use a pipet to add more water to the first row so that it is ¾ full. Test the conductivity of each water solution in the top row by dipping both electrodes into each well of the first row of the reaction plate. You may have to tilt the plate slightly for the electrodes to dip into the solution. Test the water solutions only, not the ethanol solutions.

    IMPORTANT: Be sure to rinse the electrodes and dry them with a paper towel after each test. If the bulb of the conductivity apparatus lights up, the solution conducts electric current. Record your results in **Table 1.**

11. Clean the reaction plate by dumping the solutions into the chemical trash. Pour a solution of soapy water into the reaction plate and scrub each well that was used with a cotton swab. Throw the aluminum foil tray into the chemical trash. Wash your hands thoroughly before you leave the lab and after all work is finished.

Observations

TABLE 1 CHARACTERISTICS OF COMPOUNDS

Compound	Description	Melting point	Solubility in H_2O	Solubility in ethanol	Conductivity
Calcium chloride					
Citric acid					
Phenyl salicylate					
Potassium iodide					
Sodium chloride					
Sucrose					

Questions

1. **Organizing Results** List the white substances into two groups according to their properties.

2. **Organizing Results** List the properties of each group.

3. **Inferring Conclusions** Use your textbook and your experimental data to determine which of the groups consists of ionic compounds and which consists of covalent compounds.

4. **Relating Ideas** Write a statement to summarize the properties of ionic compounds and another statement to summarize the properties of covalent compounds.